Please return or email comments to Aaron by 330pm Tuesday Thanks

PERFORMANCE TESTING PROCEDURE- May 6, 2002, AN

Test Objective- Conduct a 950 MW gross test run over an extended 3 day test period at normal operating conditions to document problems and concerns in maintaining main steam superheat and reheat temperatures including use of main steam and reheat desuperheating sprays, reheat and primary superheat bias dampers, and sootblowing Information derived from this test will help determine if additional superheat surface area is required in the boiler.

OPERATING PARAMETERS: **IGS UNIT 2**

Test Date and Time: 3 day teat run from Tuesday 5/12/2002 17:00 to Friday 5/17/2002 15:00 (immediately following the 10 hour turbine test at Valves Wide Open/ 985 MW gross)

Load, gross	**950 MWgross**
Throttle pressure	~2350 psig
Control valve position	~50%

Normal Operating Conditions
Turbine Setup- local control, AGC- out of service
Boiler Setup- set to control desired throttle pressure. For this test series, the main objective is to achieve Main Steam and Hot Reheat temps, Econ Gas Outlet Temp (EGOT) is secondary and will be documented to determine impact on boiler efficiency.

Throttle Temperature 1005 F
During the previous high load tests, there was a calibration problem on the main steam sprays controller. Main steam spray flow was false was helping to suppress temperatures. This problem has been resolved.

Hot Reheat Temperature 1005 F
Set up boiler to control reheat temps with bias dampers (no reheat sprays, if possible). Please document if any problems.

Sootblowing
Please follow normal sootblowing schedules. However if these are inadequate please document on the Operation's- Observations Log (a copy attached to the back of this procedure).

Water and Steam Cycle Isolation- normal operational setup

Generator Power Factor- MVAR target of 50 -60, need to supply own MVAR support for Unit 2 auxiliary power. Power Factor needs to be 0.985 lagging to 1.0 (by using the other generator to supply the reactive power required by the station)

Generator Hydrogen Pressure= 63 psi or higher

Equipment:

AUXILIARY POWER- Please have Air Compressor D running (prior to the test), due to low bus voltage concerns. Do not start A/C D during the test series, the air compressor motors are "small" motors with a 90% voltage start limit on them.

Pulverizer operation- 7 requested
Remove pulverizer primary air flow or coal flow bias, unless absolutely necessary

All cooling tower fans need to be in service.

NOTES:

BOILER CYCLE LIMITATIONS: The maximum steam flow relieving of the boiler relief valve system is **6,900 KPPH.** This is our maximum capacity limitation.

BOILER FEED PUMPS: note- BFP 1B has been upgraded and runs with a bias to keep both feed pumps with the same pressure output

ELECTRICAL SYSTEM
While testing the unit at high power output (> 900 MWg) you should be aware of the following limits or constraints of the electrical system.

Generator
The generator is designed for the following rated conditions:

991	MVA	26	kV	22,006	I_A
0.90	PF	5363	I_F	63	psig H_2

At loads above 891 MWg the power factor must be raised above 0.90 to stay within the generator capability curve. For testing at 975 MWg the power factor must be above 0.985 lagging. Ideally, the power factor should be set to unity by using the other generator to supply the reactive power required by the station.

In the operating range of 891 to 991 MWg the capacity of the generator is limited by armature heating. All of the generator RTDs and thermocouples should be monitored during the test to verify the temperature of the generator winding stays within design limits. Although you should monitor all of the generator temperature indications , pay particular attention to the following design and alarm limits.

Estimated water outlet temp. (46 C inlet water) at max capability	62 C
High inlet water temperature alarm	48 C (± 1 C)
High water outlet temperature alarm	81 C (± 1 C)
High water outlet temperature trip	86 C (+0/-2 C)

High stator bar outlet temp alarm	86 C (± 1 C)
High stator temp between stator bars	81 C (± 1 C)
High P bar outlet temp	65 C (± 1 C)
Estimated connection ring outlet temp at max capability	55 C
Connection ring outlet temperature alarm	65 C

The temperatures should be monitored using the TGSI system not the PI system.

The generator rating, of 991 MVA, requires a hydrogen gas pressure of 63 psig. For every 1 psi drop in hydrogen gas pressure the generator capability is reduced by 8 MW. At 61 psig, hydrogen gas pressure, the generator must be operated at unity power factor to stay within the generator capability curve, if the generator output is 975 MWg.

Generators are designed to operate continuously at rated kVA, frequency and power factor over a range of 95 to 105% of rated voltage. Operation beyond rated kVA may result in harmful stator over current. Note, at rated kVA, 95% rated voltage, stator current will be 105% . This is permissible. You should carefully monitor the stator current. Do not exceed the rated current of 22,006 amperes unless you calculate the current limit at lower operating voltages (within the ±5% of rated voltage) and you are within those limits. Do not exceed 23,106 amperes for any reason.

Do not operate above the rated kVA of the generator and try to rely on temperature indication to indicate excessive stator currents since unmonitored phenomena such as temperature in other parts of the stator circuit, winding forces, abnormal magnetic field, etc may become excessive.

Operation of the generator with lagging power factor, beyond the limits of the capability curve, may result in overheating the field winding. Increasing the field current will lower the power factor. If you try to lower the power factor (and increase the field current) beyond rated, the maximum excitation limit will activate. The maximum excitation limit is set to 105 % of rated field current (5630 amperes). If this limit is exceeded, an inverse time versus current signal is generated (the higher the current level the shorter the time). After a time delay, the generator will transfer from AC to DC control. If the field current is not reduced below 105%, by the transfer, the generator will trip.

The generator is also protected from under excitation by the underexcited reactive ampere limit. If the AC control system causes operation of the generator to be outside the capability curve (leading power factor region) the URAL control will take over and limit the excitation system. This curve is presently set to not allow leading power factor operation at 975 MWg.

Isophase Bus Duct

The isophase bus is rated for 23,100 amperes at 26 kV. At rated current, the maximum rise, above a 40 C ambient, was designed to be 65 C on the conductor and 40 C on the enclosure. Because our operating experience indicated the bus conductor and enclosure were operating at a higher temperature than design, a forced cooling system was installed on the Unit 2 Isophase Bus in March 2002. Although this cooling system only provides cooling from the generator terminal to the generator circuit breaker the rating for this section of bus is now 24,500 amperes with a 75 C rise on the conductor. The bus is presently configured to handle the maximum output of the generator

(23,106 amperes) without any problems as long as the forced cooling system is running.

Generator Step-Up Transformer

The generator step-up transformer is rated at 865 MVA with a 55 C rise and 968.8 MVA with a 65 C rise. Because part of the output of the generator is sent to the auxiliary transformers the generator step-up transformer is not expected to be loaded above nameplate limits. In addition oil filled transformers have an inherent overload capability. The generator step-up transformer temperatures should be monitored during the test. The oil temperature is set to alarm at 91 C and the winding temperatures alarm at 120 C.

PERFORMANCE TEST **IGS UNIT 2** at 950 MWgross

Test Date and Times: 3 day test run from Tuesday 5/12/2002 17:00 to Friday 5/17/2002 15:00

Test Objective- To document problems and concerns in achieving and maintaining main steam superheat and reheat temperatures including main steam and reheat desuperheating sprays, reheat & prim superheat bias dampers, sootblowing usage, economizer exit gas temperatures and tube metal temperatures at the higher 950 MW gross load levels over an extended 3 day test period. Information derived from this test will help determine if additional superheat surface area is needed.

OPERATIONS- OBSERVATIONS LOG:

Please note any observations, problems, concerns, suggestions or recommendations. Include: comments on sootblowing usage- are we having to blow certain sootblowers more frequently, do we have adequate superheat desuperheating spray flow for normal temperature control, do we need to decrease the reheat bias damper minimum stop position because we have too much reheat temperature, etc. etc..

Record date, time, name, Operations Crew and comments.
Please return at the end of the test series to the Engineering, Results Group (Garry Christensen, Dave Spence or Aaron Nissen).

DATE	TIME	NAME	CREW	COMMENTS

IPSC

EQUIPMENT BID AND RECORD

USE 24HR TIME FORMAT

Requested by Aaron Nissen Div. IPSC Sec. IGS Submitted by _____ (Operator) _____ (Time) _____ (Date)

☐ Out of Service
☐ Clearance TO Aaron Nissen/ David Spence/ Garry Christensen (Responsible Party) Div. IPSC Sec. IGS
☒ O.K.

EQUIPMENT REQUESTED: IGS Unit 2 Boiler Performance Tests- 950 MWgross ~2350 psi throttle press/ ~50% valve position/ 1005F throttle temp/ 1005F HotReheat

NATURE OF WORK: Test Objective- To determine problems and concerns in maintaining main steam superheat and reheat temperatures including use of main steam and reheat desuperheating sprays, reheat & prim superheat bias dampers, sootblowing usage, economizer exit gas temperatures and tube metal temperatures at the higher 950 MW gross load levels over an extended 3 day test period

BID Time
FROM: Monday (Time) 1700 MDST (Date) 05/14/02 **TO:** Friday (Time) 1500 MDST (Date) 05/17/02

WORK Time
FROM: Monday (Time) 1700 MDST (Date) 05/14/02 **TO:** Friday (Time) 1500 MDST (Date) 05/17/02

PREPARATION REQUIRED: Test Conditions- Turbine in local control, AGC off, normal operating conditions, 7 pulverizer operation, all cooling tower fans need to be in service. Remove unnecessary pulverizer, fan, and BFP biases. NOTE: auxiliary power- have air compressor D I/S prior to test.

BID APPROVED:

OPS Supv. _____ (Time) _____ (Date) Removed by _____ (Time) _____ (Date)

Supt. _____ (Time) _____ (Date) Issued to _____ (Time) _____ (Date)

Dispatcher _____ (Time) _____ (Date) Returned by _____ (Time) _____ (Date)

EQUIPMENT NORMAL: _____ (Time) _____ (Date) By _____ (Operator) _____ (Supv.)

Remarks: _____

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